U.S. Department of Agriculture Agricultural Research Service April 1992

Agricultural Research

Spotlighting Students in Science

FORUM

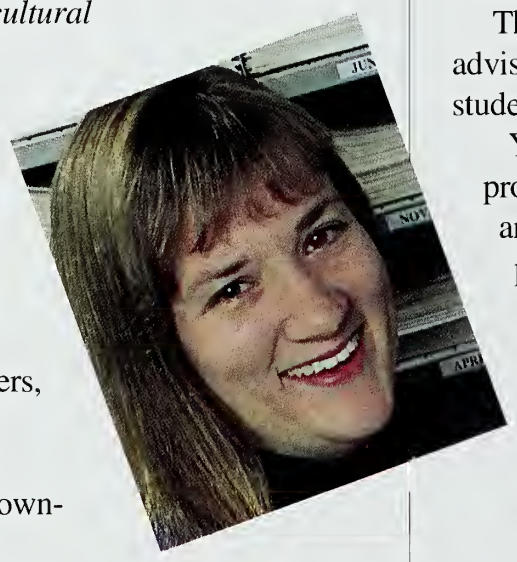
Notes from our summer staffer

Last year, my sophomore year of college, I toured ARS' National Visitor Center in Beltsville, Maryland. Exhibits there involved insects, animals, agricultural satellites, biotechnology, the environment, human nutrition, and plants. Since my major at the University of Maryland is genetics, I began to daydream about someday conducting my own research projects.

Luckily, I found an opening for a summer internship with the ARS Information Staff.

When I started the job in June, the first thing I noticed about ARS employees in general was that they were really INTO their work. Just strolling through the halls and glancing into offices, I spotted an array of pictures of every kind of plant and animal under the sun. Proud displays of fresh fruits and vegetables, cow and sheep pastures, cornfields, and grocery store produce departments decorated their offices and hallways. Right away, I knew I would be working with colorful, enthusiastic people.

Through the summer, I worked in the Publications Branch, the part of the Information Staff that, among other things, produces *Agricultural Research* magazine. I couldn't believe the complexity of the operation: planning, generating ideas for stories, interviewing scientists, writing articles, creating artwork and photography, meeting deadlines, editing, formatting, and finally, distribution.



Along with helping editors, writers, and photographers, I helped handle public correspondence, fed hungry databases, and made deliveries to downtown Washington, D.C.

But I think the best part about working on the Information Staff was that I got an appreciation for the vast array of research at ARS. At spare moments between answering phones and my "gophering" duties, I found myself constantly picking up publications and skimming through them. I learned that agricultural research is more important than most people realize. It touches our lives in every way—from our clothes to everything we eat.

When the summer ended, I applied for a half time position and was hired by plant physiologist Lowell Owens. Starting in September, I've been working part-time in his tissue culture lab during school semesters and full time during summer and winter breaks.

Thank you, ARS, for your student employment programs!

Terrie Weaver, Class of '93
University of Maryland

Today's Students—Tomorrow's Workforce

Year after year, students like Terrie Weaver enrich the Agricultural Research Service with their energy, talent, new ideas, and fresh insights. This special issue of Agricultural Research affords an opportunity to recognize some of their contributions.

In the face of public concerns about dwindling student interest in science and engineering, ARS manages each year to find students who are up to the challenges and eager to know more about agriculture's unique research perspective.

This is not to diminish our anxieties about the employment pool of the future; far too few high school graduates are expected to earn degrees in science and engineering. And we're still concerned about the mix: We expect more than half of this country's workforce to be composed of women and minorities by the year 2000, but Blacks, Hispanics, and women remain under-represented in virtually all scientific professions.

That's why ARS is deeply indebted to each mentor, adviser, supervisor, teacher, and volunteer who facilitates student development, either formally or informally.

You are the people who give of yourselves to make programs like our Teachers Research Fellowship Program and College Work-Study Program work. You're also the people who stop for a moment to explain the hard science behind a curious observation, who encourage the keen young student to keep struggling with an equation, who demonstrate a few programming tricks to the youngster down the hall doing data entry.

R.D. Plowman, Administrator
Agricultural Research Service

Agricultural Research

Cover: John F. Kennedy High School students Christopher Thompson, Angela Archer, and Sean Gros use a rotary evaporator to concentrate a bacterial culture in an Agricultural Research Service laboratory in New Orleans, Louisiana.
Photo by Scott Bauer. (K-4604-1)

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Vol. 40, No. 4
April 1992

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Agricultural Research is published monthly by the Agricultural Research Service, U.S. Department of Agriculture, Washington, DC 20250-2350.
The Secretary of Agriculture has determined that publication of this periodical is necessary in the transaction of public business required by law.

Subscription requests should be placed with New Orders, Superintendent of Documents, P.O. Box 371954, Pittsburgh, PA 15250-7954.

Address magazine inquiries or comments to: The Editor, Information Staff, Room 316, Bldg. 005, 10300 Baltimore Ave., Beltsville Agricultural Research Center-West, Beltsville, MD 20705.

When writing to request address changes or deletions, please include a recent address label.

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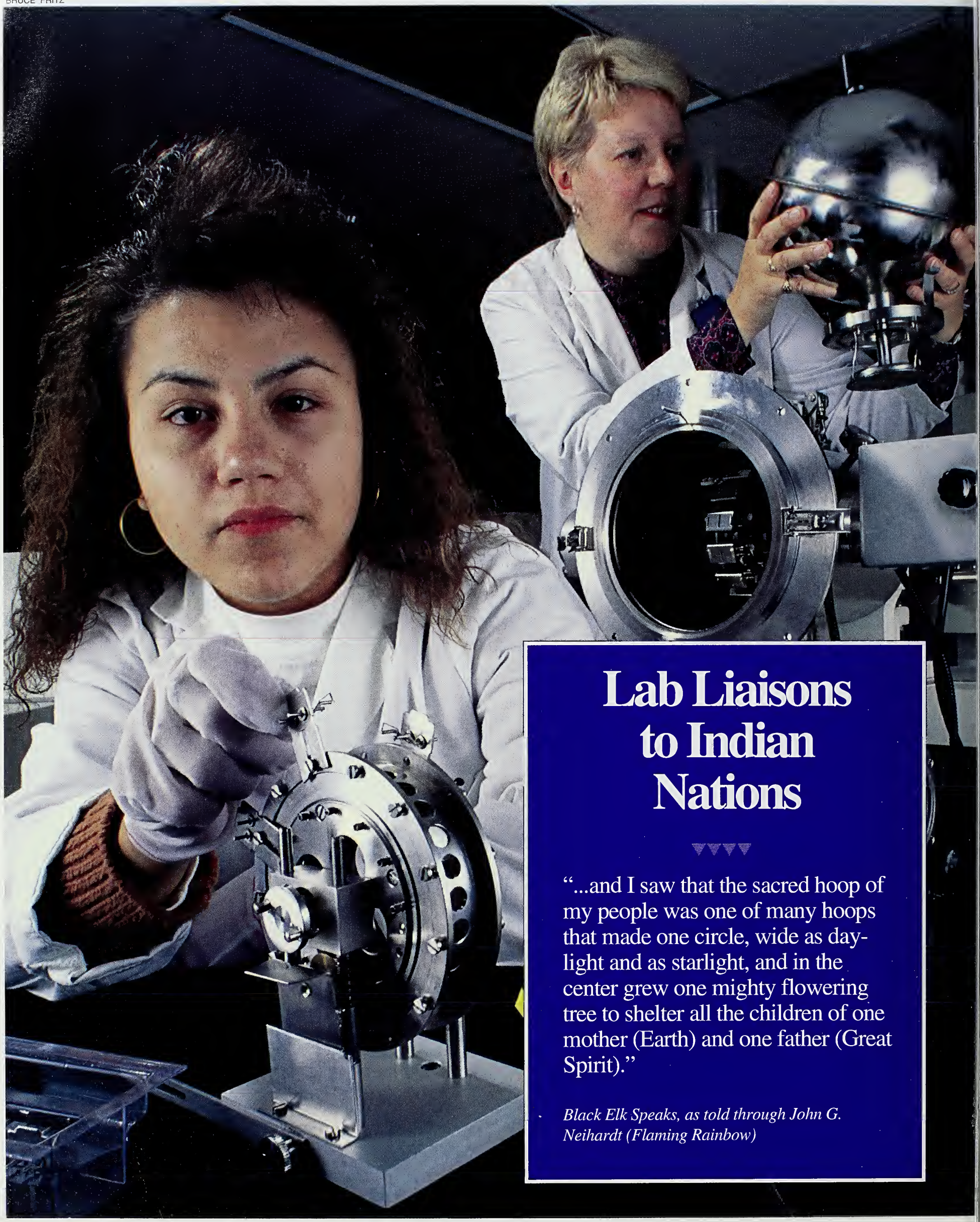
BRUCE FRITZ



Lab Liaisons to Indian Nations

"...and I saw that the sacred hoop of my people was one of many hoops that made one circle, wide as daylight and as starlight, and in the center grew one mighty flowering tree to shelter all the children of one mother (Earth) and one father (Great Spirit)."

Black Elk Speaks, as told through John G. Neihardt (Flaming Rainbow)

Nicholas Black Elk never lived to see his vision as a 9-year-old boy come to pass. An Oglala Sioux, he saw instead "my nation's hoop broken and scattered" after the massacre of his people at Wounded Knee, South Dakota, December 29, 1890. Black Elk was a medicine man—and a great one by historical accounts. A medicine man is a spiritual leader of his tribe who heals by treating body, mind, and spirit.

Medicine men are, of course, no longer much in demand as Western medicine has become entrenched on reservations across the country.

So Mike Colombe plans to be a doctor. Alyssa Martinez—a great-granddaughter of Nicholas Black Elk—has pretty much decided on nursing. And Ellie Giron wants to be a medical technologist. They are three Native American students at the University of North Dakota (UND) currently working part time at the ARS Grand Forks Human Nutrition Research Center under a special program begun in the fall of 1988.

"I always wanted to be a doctor," says Colombe. But, he adds, "I would have loved to be a medicine man. It's more traditional. It's not only the way our people have dealt with sickness. . . the medicine man was the religious leader of the tribe."

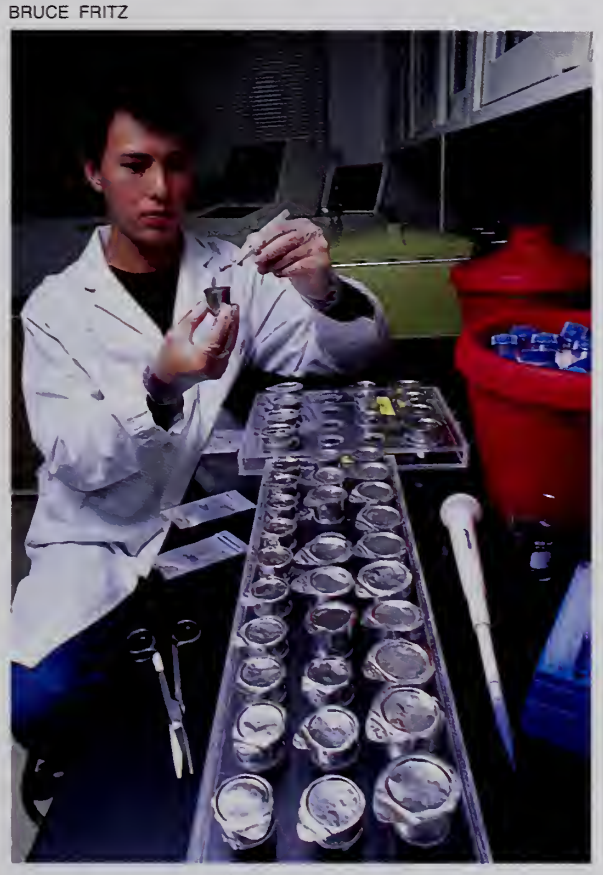
Colombe, who is one-half Sioux and one-half French, hails from the Rosebud Sioux Tribe in South Dakota, where Kevin Costner recruited many actors and extras for his Academy Award-winning movie "Dances With Wolves."

In fact, one local actress also translated the movie script into Lakota—Colombe's native tongue. She teaches the language at the college on his reservation, he says, which "is bigger than Rhode Island and Connecticut together."

Colombe began working with Eric Uthus at the ARS center about a year ago after Martinez left the position to spend more time on her studies.

A sophomore majoring in chemistry, Colombe works 2 to 3 hours each weekday helping to run chemical assays for the group's experiments on elements such as arsenic, nickel, and silicon that may be essential in trace amounts. He's learning to analyze for these metals as well as for cholesterol, triglycerides, and proteins. He says Uthus trains him to operate an array of instruments and work the calculations.

BRUCE FRITZ



Biological aide Mike Colombe assists in research on ultra-trace element needs in human nutrition. (K-4543-1)

"I think I'd do it just for the experience and knowledge of it all," Colombe says. "But it's nice to get paid on top of that, too." In fact, the pay—at a GS 1 rate—is about $1.00 per hour more than the minimum wage paid to most UND students.

The idea to hire Native American students as biological laboratory aides was triggered by an article in a supermarket throwaway, says Phyllis Johnson, a research leader at the center until last October.

According to the article, the university has one of the largest enrollments and the highest graduation rate of Native Americans in the country. It struck her: here was a workable answer to the center's support staff need.

Working with ARS personnel specialists, Johnson got three new positions for students on 180-hour appointments, which can be renewed until they graduate. About 30 students responded for the three slots, she says, and now when one opens up, the students do the advertising through their own grapevine.

Uthus says he "jumped on the opportunity to get qualified help. It's tough even to get temporary help." Altogether, seven students have been or are currently in the program.

Its purpose is to "steer students in the direction of science, so we can hire them when they finish their degrees," explains Johnson, who moved to Albany, California, last fall to take over as associate director of ARS' Pacific West Area. So far, she says, "we've interested one student in pursuing a research career when she hadn't thought that was what she wanted to do."

No one has to coax Ellie Giron. "My main goal is to go into research," says the newest student employee. "I'm one of those people who like to dig deep." Giron, a sophomore, was delighted to hear of an opening in Johnson's lab last August. Even though Johnson has left, the work goes on with a lot of blood, sweat, and urine—but no tears. Lab staff analyze thousands of samples from volunteers who consume special diets and donate their body fluids in studies to establish how much zinc, copper, or manganese we humans really need to consume.

Among her many duties, Giron prefers making filaments. She meticulously adds a drop of extracts of blood serum, sweat, or urine to the flat side of a filament "that looks like a staple" and

Biological aide Ellie Giron (left) and ARS chemist Phyllis Johnson prepare a sample for analysis at the ARS Grand Forks Human Nutrition Research Center in Grand Forks, North Dakota. (K-4542-1)

puts it on the rotating head of a mass spectrometer for analysis.

"The pay is really good and so is the experience," says Giron who especially likes working with four medical technologists—her major field of study. She also likes the peace and quiet of lab work. "There's more concentration. You can get more into your work."

Her home is in Belcourt, North Dakota, on the Turtle Mountain Reservation—"one of the largest in North Dakota," she says. She is one-quarter Chippewa; the rest of her ancestry is Mexican and French Canadian.

In the top 10 percent of her high-school class, Giron attends the university on an Indian Health Service (IHS) Scholarship, which provides tuition, books, travel money, and a stipend for living expenses. When she completes the 5-year med tech program, she will spend 4 years in an IHS hospital to fulfill her obligation before she can attain her goal of researcher.

Like most of the Native Americans who have worked at the center, Giron is in the university's INMED (Indians into Medicine) program, which assists students interested in pursuing a health-related career with curriculum advice, scholarship applications, and tutoring, if needed. She serves as secretary of INMED this year.

Alyssa Martinez is the veteran Native American employee at the ARS center. In fact, Martinez, now a senior, helped at the center during an INMED-sponsored summer program for incoming freshmen, even before the Native American program began.

BRUCE FRITZ

Biological aide Alyssa Martinez feeds growth medium to a cell culture as chemist Phillip Reeves supervises. (K-4544-2)

She worked in Uthus's lab then and returned there in the fall of 1988, where she stayed until the end of 1990.

"I missed working here. I couldn't see myself working any place else," she says. So she returned again last fall to fill an opening in Phil Reeves' lab. "You can incorporate what you learn in school at work and vice versa," she notes.

She is learning to reculture endothelial cells—which normally line blood vessels—and prepare the medium that bathes and nourishes them. The cultures allow Reeves and his coworkers to study how zinc deficiency lowers blood pressure in animals. "We may be able to use this knowledge to help regulate blood pressure in humans," Reeves says.

Martinez, who also has an IHS scholarship, is studying nursing but may still switch to medical technology, "so I can go into research." Whatever she chooses, she ultimately wants to return to her own reservation to work. "A lot of people who come from reservations see the problems and want to do something," she says. "We're kind of 'save the world' people."

Her home is Cannonball, North Dakota, on the Standing Rock Reservation, which extends across the border into South Dakota. But her local school was weak in the sciences, she says, so she finished high school in Wyoming's Wind River Reservation—home of Arapaho and Shoshoni tribes—where an aunt and uncle live. Her native tongue, Dakota, is very similar to Colombe's Lakota, she says.

In addition to her studies and part-time job, Martinez serves on the boards of two Native American organizations on campus. As vice president of the Indian Association, she says she gets to put on the "big pow wow" next month, in which Indian students share their cultures with others by performing native dances. And as vice president of the UND chapter of the American Indian Science and Engineering Society, she traveled to Albuquerque last November for her third national conference.

Martinez is one-half Sioux, one-quarter Crow, and one-quarter "other," which does not include any Spanish ancestry in spite of her surname, she says. That came from a man who adopted her grandfather—whose real father was Nicholas Black Elk, the medicine man.

"My grandma used to tell me about their Indian medicines. And I thought it would be so interesting to do research combining traditional and modern medicine," says Martinez. She and a friend share a private dream for such a research center some day.—By **Judy McBride,** ARS. ◆

Sweet Success in Texas

For Sarah E. Lingle, supervisory plant physiologist at the Subtropical Fruit and Vegetable Research Laboratory at Weslaco, Texas, the data was unexpected. But she didn't doubt its accuracy. Instead, she would have to revise her hypothesis—almost reverse it, as a matter of fact.

Lingle's research was aimed at finding the key biochemical steps in the ripening of sugarcane and the genetic mechanisms behind them. Such information could facilitate the selection or development of sugarcane varieties with higher concentrations of sucrose. Her hypothesis concerned the role of an enzyme called sucrose synthase in the ripening process.

Studies by other scientists suggested that the sucrose synthase enzyme—which appeared to break sucrose down so that it could be metabolized by the plant—was more active in immature, rapidly growing sugarcane stems. Such tissue exhibited higher sucrose synthase activity, according to the studies, and was therefore better able to import sugar from the leaves.

If so, Lingle reasoned, the enzyme's activity should decrease when the tissue was no longer growing and was ripening instead. More sugar would then accumulate in the mature, ripening stem since it wasn't needed elsewhere.

But that was not the case. Nor was the premise correct.

"We found that ripening was associated with an increase only in the percentage of stem sugar that was sucrose," says Lingle, "not an increase in the sugar itself."

According to Lingle, sucrose synthase activity turned out to be highest in mature stem tissue, not the immature, growing tissue as previously thought. Evidently, ripening in sugarcane was not caused by unmetabolized sugar going to mature stems for storage.

"Our data suggest that ripening in sugarcane is caused by something else that happens to the sugar when it reaches a particular tissue," she says. "It may be related to changes in sucrose synthase activity, but we're not sure. That's one of the things we'll be looking at next."

DAVID NANCE

Under the supervision of ARS plant physiologist Sarah Lingle, pre-med student Ruben Salinas, Jr., extracts enzymes from sugarcane at the Subtropical Fruit and Vegetable Research Laboratory in Weslaco, Texas. (K-4595-1)

A significant portion of the data used by Lingle was gathered by Ruben Salinas, Jr., a recent high school graduate who worked at the laboratory last summer before beginning his freshman year as a pre-med student at Texas Christian University.

"We were fortunate in having Ruben," says Lingle. "He was a big help to us. He proved to be a quick learner, was analytical, and accuracy was clearly important to him. I like to give people as much responsibility as they are willing and able to handle, and I was quite comfortable leaving certain aspects of the project up to him."

Ruben's responsibilities at the laboratory included chemically extracting enzymes from sugarcane tissue and conducting spectraphotometric analyses of these enzymes as well as ion chromatographic analyses of sugar from the same tissue.

"At first I felt a little overwhelmed by all the instrumentation and the prospects of having to learn how to operate it," he says. "I'd been in chemistry labs in high school, but nothing like this. The first time I was here, I can remember my nervousness on seeing radiation warning signs. I knew that radioactive isotopes were commonly used in scientific research, but I was still relieved when Dr. Lingle assured me that she would be the one handling them."

Ruben Salinas, Jr., is a first generation American, the oldest of four children of Ruben and Olga Salinas who immigrated from Mexico in 1973.

Ruben Sr. worked as a heavy equipment operator on road construction. Olga made ends meet with sewing jobs. Neither of them spoke English when they came to the United States; Spanish is still the language of choice in their home. But both were determined that their children have all the opportunities that citizenship and a good education can offer.

That he did, graduating fifth from the top of a Weslaco High School senior class of 491. He also rose to the rank of battalion commander of the school's Army ROTC and will be receiving an ROTC college scholarship beginning his sophomore year.—By **Steve Miller,** ARS. ◆

Saving the Trees From Gypsy Moths

It's a warm July morning, and high school and college students crowd the sunny beaches of Avalon, New Jersey. But several miles inland, two students and a scientist have parked their truck at the edge of a forest and are preparing to get to work.

Just off the road from where they stopped, dozens of tree stumps jut like tombstones among low shrubs and grass. If the stumps—of oak, pitch pine, and other trees—had epitaphs, they might read, "Died of the Gypsy Moth."

Loose in this country since about 1868, the gypsy moth spread from Massachusetts to attack trees in forests, parks, and residential areas throughout the northeastern and mid-Atlantic states and in parts of the Midwest. In 1991, the moths stripped the leaves from trees on an estimated 4 million acres—an area the size of Delaware.

To reduce fire hazards from moth-killed trees in the 13,000-acre Belleplain State Forest, the State of New Jersey lets people chop them down to burn in their fireplaces, explains Philip Taylor. Taylor is a scientist at the ARS Beneficial Insects Introduction Research Laboratory in Newark, Delaware.

The Newark lab is also the U.S. point of entry for beneficial insects collected by ARS scientists based in labs overseas. Entomologists at the lab test natural enemies of the gypsy moth and other pests. Along with cooperators at other ARS labs and universities, they also monitor the gypsy moth's destruction of trees.

Gypsy moths haven't finished with Belleplain yet, and Taylor, Ronald James, and Tanesha Roberts are here to help foretell the future. They'll snoop on the moths' reproductive plans by counting masses of moth eggs primed to hatch in the spring of 1992.

It's a scientific ritual that's been followed at Belleplain by teams of ARS scientists and high school and college students almost every week from May through August for the last 10 years.

For Newark's summer student contingent, the egg counts serve as initiation rites for the nitty-gritty of scientific field studies.

Tanesha Roberts, a junior at Delaware State College in Dover, is working at ARS as a USDA summer intern. Sure, she needs money for school—but why is a future pediatrician working at an insect laboratory? "It was a challenge—to see if I could hack it," she says. "Not so much the insects but the field sites—the mosquitoes and the heat."

In Belleplain, she knows, carpenter bees and hornets patrol for pollen and prey, snakes hide under decaying logs, and mosquitoes and ticks wait for meals of blood. Even the plant world can threaten, what with brambles, poison ivy, and the hazard of falling tree limbs.

SCOTT BAUER

College senior Ron James counts gypsy moth egg masses on trees, as summer intern Tanesha Roberts selects a tree for sampling using a forester's wedge prism. (K-4263-4)

ARS Programs for Student and Temporary Employment

- Applicants must be at least 16 years of age, be a citizen or permanent resident, and may not be hired for a position under the supervision of a relative.
- All salaried full-time and part-time employees earn sick leave.
- Salaries are above minimum wage unless otherwise stated and depend on the level of skill required.
- Minorities and females are encouraged to participate in all programs.

Career-Related Programs	Student status	Work schedule	Insurance (health/life)	Apply to	Lead time for appl.
Co-op Education—provides flexibility in integrating academic studies with career-related work experience for **students** in high school, trade, technical, business or vocational school, and associate, baccalaureate, or graduate programs.	variable	individualized	eligible	educational institution	1 month
Federal Jr. Fellow—provides summer and vacation employment for graduating **high school seniors** headed for college. Must be nominated by school official. Overall evaluation should be at least "C+."	full time or part time	part time except during summer and vacations	eligible	high school	1 month
Research apprenticeship—provides **high school students** with 8 weeks of experience working with scientists in food and agriculture research.	full time	summer	ineligible	high school or ARS *	varies
1040—provides **high-school** and **college students** with practical experience assisting scientific, professional, or technical employees not to exceed 1,040 hours per year.	full time	part time, full time, or intermittent	ineligible	ARS*	1 month
Teachers Research Fellowship—provides **teachers** the opportunity to gain first-hand scientific experience/exposure and the ability to relay that information to the students.	not appl.	summer and vacation	ineligible	ARS*	3 months

*Write to USDA-ARS, Personnel Division, Personnel Policy and Systems Branch, 6305 Ivy Lane, Greenbelt, MD 20770-1435

Over

Programs Based on Income	Student status	Work schedule	Insurance (health/life)	Apply to	Lead time for appl.
College Work Study—provides part-time earnings for **college students** to pursue their education at institutions participating in this program.	half time	part time (set by college)	ineligible	educational institution	1 month
Stay-in-School—provides needed earnings for **high-school** and **undergraduate college students** to continue their education.	full time	part time, full time, and/or summers	ineligible	educational institution	1 month
Summer Aid—provides jobs for **needy young people**. Minimum wages.	none	summer	ineligible	state employment service	3 months
Other Programs					
L/A Appointment—enables ARS locations to hire **anyone** for field/laboratory work for 180 days per year. Applicants may be 16 or older if high school graduate, otherwise 18 minimum age.	none	part time, full time, or intermittent	ineligible	ARS*	varies
Summer Employment—provides employment for **anyone** from May 13 through September 30.	none	summer	ineligible	ARS*	3 months
Volunteer—provides **anyone** the opportunity to gain work experience related to his or her educational objectives. No salary.	none	part time, full time, or intermittent	ineligible	ARS*	1 month

*Write to USDA-ARS, Personnel Division, Personnel Policy and Systems Branch, 6305 Ivy Lane, Greenbelt, MD 20770-1435

"The atmosphere here is one of learning and helps bring my own lab work at school more into focus."

So, before heading to the sampling sites, the trio pull on knee-high boots and apply hardhats and bug repellant. Then they gather up their tools—including data charts, compass, tape measure, can of spray paint, binoculars—and head for the tree cemetery.

It's not yet noon, but Ronald James, a senior at Lincoln University in Pennsylvania, has already had a long day. Before the 75-mile trip from Newark to Belleplain, he'd driven 45 miles to the lab from his home in Coatesville, Pennsylvania. The future high-school math teacher hopes eventually to earn a doctorate in education. He's employed with ARS under his university's LASER (for Lincoln Advanced Science Engineering Reinforcement) program.

Scientist Apprentices

The Newark lab and the agency's Eastern Regional Research Center in Philadelphia participate in the program, aimed at giving Lincoln students a taste of a science career along with summer jobs to help them pay for their college education. Since 1987, the agency has placed 14 Lincoln students in ARS jobs through the LASER program.

James thinks his experience at ARS will help him become a better teacher. "The atmosphere here is one of learning and helps bring my own lab work at school more into focus," he says. Showing other students how to cope with Belleplain, he adds, gives him some "teaching" experience.

While Roberts, James, and Taylor troop into the woods, five other students are hard at work in the Newark laboratory. The five, students from local high schools, are working as research apprentices. That means they run their own experiments as well as help the lab scientists with theirs.

Rachael Cameron and William Osborne are due to graduate from Newark High School in 1992. It's probably safe to say they're the school's resident experts on beneficial insects, such as lady beetles, which prey on aphids and other buggy pests of garden and farm crops.

Do species of lady beetles differ, Cameron wonders, in where they like to lay their eggs? To find out, she ran an experiment in which she checked daily on the number and placement of eggs laid by various lady beetle species kept in several cardboard containers. The containers held bits of soda straw, felt, pebbles, and leaves that she had placed as potential egglaying sites.

Her six-legged charges don't show any strong preferences. "They all seem to like to hide their eggs under something," she says.

To keep the lady beetles fed, Cameron and Paul Schaefer, a Newark entomologist, collected aphids from reeds near the Delaware River. Then Cameron reared larger supplies of aphids on fava bean plants in the lab.

Will Osborne is a track letterman whose team ran third at the Delaware state meet in 1991. In college he plans to chase another long-time interest—marine biology. As a young child, he remembers reading voraciously about sea lions in old magazines his mother brought home from her hospital job. Now, whether he's rearing gypsy moths for the researchers' studies or rescuing Tanesha Roberts from Belleplain's carpenter bees, Osborne says he learns about science "by working at it instead of just reading or hearing about it."

Newark's other research apprentices in the summer of 1991 are now college freshmen. Psych major Rob Neal and chem major Jennifer Lee—Newark High class of '91—attend the University of Delaware next door to the ARS lab. Jim Bruton, graduate of Brandywine High School in Wilmington, Delaware, studies chemistry at the University of Richmond in Virginia.

Last summer was Bruton's second as a Newark apprentice. His dislike of gypsy moths is personal. "They've killed four trees in our yard," he reports.

Working with Newark's biocontrol researchers "taught me a lot about the way things interact," he adds. "There are different ways, which nature provides, to handle pests. We should spend more time trying to find natural ways instead of rushing to use some insecticide."

In 1991, one of Bruton's projects at Newark was to see if gravity determined which end of a gypsy moth pupa (the cocoon stage) would form the exit door for departing parasitic wasps.

The wasps, *Coccygomimus disparis,* hatch from eggs laid by a female wasp inside the moth pupa. Then the immature wasps devour the pest from

the inside before emerging as adults. For his study, Bruton needed gypsy moth pupae "stung and hung" either head up or head down. Gravity apparently doesn't matter, he found: the wasps seemed to prefer exiting through a pupa's softer, anterior (head) end.

Still, for Bruton the experiment was a success. "Paul Schaefer gave me this research project," he says, "to help me develop my skills. It did that, and also showed me that what I learned in school—the five-step scientific method—is true. But I also learned science isn't always big and fancy—how you see it in the movies. I even built some of the equipment I needed." That included drilling holes in petri dishes, into which he inserted gypsy moth pupae for the wasps to sting.

Counting the Masses, One at a Time

In Belleplain, a few dozen steps carry Phil Taylor, Tanesha Roberts, and Ron James through the stump cemetery and a denser zone of huckleberry and skin-piercing brambles to thick stands of pine and oak. Many of the standing trees, though, are dead—gypsy moth victims.

Here, at the southwest corner of the sampling area—it's a 2.47-acre square—Taylor prepares to locate the first of four sampling points where the group will count egg masses. He and Ron James take turns sighting toward the east along a compass mounted atop a 5-foot pole. They confer, agreeing on which tree is on that sightline.

Then, with Roberts holding one end of the tape, James begins trudging straight toward the tree—through bramble bushes 4 feet high, and over and under fallen or leaning tree trunks—with the tape trailing behind like a lifeline.

"How far should I go, Phil?" he calls back.

"Thirty-nine meters," says Taylor, that distance being a random number between 0 and 50, picked as part of the sampling procedure. While following James's progress through the underbrush, Taylor and Roberts each keep a watchful eye on a large bee that's taken notice of them.

SCOTT BAUER

Research apprentice Jim Bruton counts lady bugs in this container to determine how many pea aphids it will take to feed them. (K-4263-17)

When James reaches the 39-meter point (128 feet), Taylor and Roberts rejoin him, and the group then locates a point 19 meters—another random number—due north. That point becomes the base for marking out two kinds of sampling areas.

One sampling area is an 8-1/3-foot diameter circle—equal to one-two-hundredth of an acre. Within that area, the group will hunt for egg masses on each bit of living and dead plant matter lying on the ground. On a chart, Taylor records the number of egg masses—tan splotches ranging from about three-eighths inch to more than an inch in diameter—Roberts and James find.

Then, using a special glass prism, Roberts identifies specific trees that have to be checked for egg masses. The prism is a handy device that ensures that only trees of a certain range of trunk diameter are checked, as called for by the sampling method. James numbers each tree with the spray paint and then uses binoculars to search for egg masses on each tree's trunk and branches from the ground up.

The crew locates three other sampling locations at this site and four at another Belleplain site before heading back to Newark—tired and dirty.

The data from the trip—and from others that summer—get plugged into a complicated mathematical formula, Taylor explains. This spring, another research team will collect the formula's final ingredient—the percentage of eggs that actually hatch. Then the formula will yield a prediction of how many gypsy moth caterpillars will hatch—and how many acres of trees they'll defoliate.

The formula's been pretty accurate, according to comparisons with later measurements of the gypsy moth's leaf-stripping activity, says Roger Fuester, the research leader at the Newark lab.

"The students who work here in the summer—from LASER and the summer intern and research apprentice programs—are vital," says Fuester, "to our ability to collect the data for the predictions and evaluate how natural enemies are affecting the moth.

"And I don't know if there's a better way for students to find out what science is like—than to just do it."—By **Jim De Quattro,** ARS. ◆

UP

With the Midnight Sun

At his job last summer, Willie Karidis was sometimes up with the sun—the midnight sun, that is. The Fairbanks, Alaska, based teacher spent the summer as an apprentice scientist, learning about how different farming practices affect soil nutrients and plant growth in the far north.

"He's had the chance to see the real nitty-gritty of science—like having to come back to the lab at 10 o'clock at night to finish a soil moisture measurement and work until midnight," says soil microbiologist Elena Sparrow. She was Karidis' mentor at the ARS Subarctic Research Unit in Fairbanks.

They worked together on a project to see how tillage practices influence the amounts of carbon, nitrogen, and phosphorus in fields sown with barley—one of Alaska's most commonly grown crops.

Karidis was one of 50 participants in last summer's Teacher's Research Fellowship Program, sponsored by the ARS. Since its inception in 1986, the program has hired teachers throughout the country as lab technicians. Hopefully, they'll take back to the classroom a sense of the challenge and excitement of solving scientific problems.

Currently a substitute teacher for Fairbanks' grade schools, Karidis holds a degree in agricultural economics from the University of Wisconsin, Madison. "But that's all book learning," Karidis notes. "It doesn't get you out there, seeing and feeling how things are really done in the lab and on the farm."

Karidis has a friendly, easy-going manner, as well as a strong interest in renewable resources and alternative sources of energy. He and his wife Nancy live in a small log cabin tucked away in a birch forest just outside of Fairbanks. Their one-room abode has electricity but is without running water—not an uncommon situation for people living outside the city limits.

Working indoors during an Alaskan summer demands discipline. The seemingly endless sunshine beckons outdoors enthusiasts like Karidis who want to take advantage of the long, bright days of summer before the dark, cold winter sets in.

"We told Willie we'd send him outside now and then to chase the sandhill cranes off the barley fields," jokes Sparrow. The graceful, 3-foot-tall cranes often raid local barley fields every summer, fattening up for their long flight back to Nebraska.

Despite the kidding, Karidis approached his laboratory work with a methodical seriousness. He donned a particle mask, for example, to carefully weigh white soda lime into tiny vials. The mask protected Karidis from inhaling the fine particles and helped him avoid adding carbon dioxide—released when we exhale—to the samples. The absorbent soda lime is used to determine the amount of carbon dioxide released from soils.

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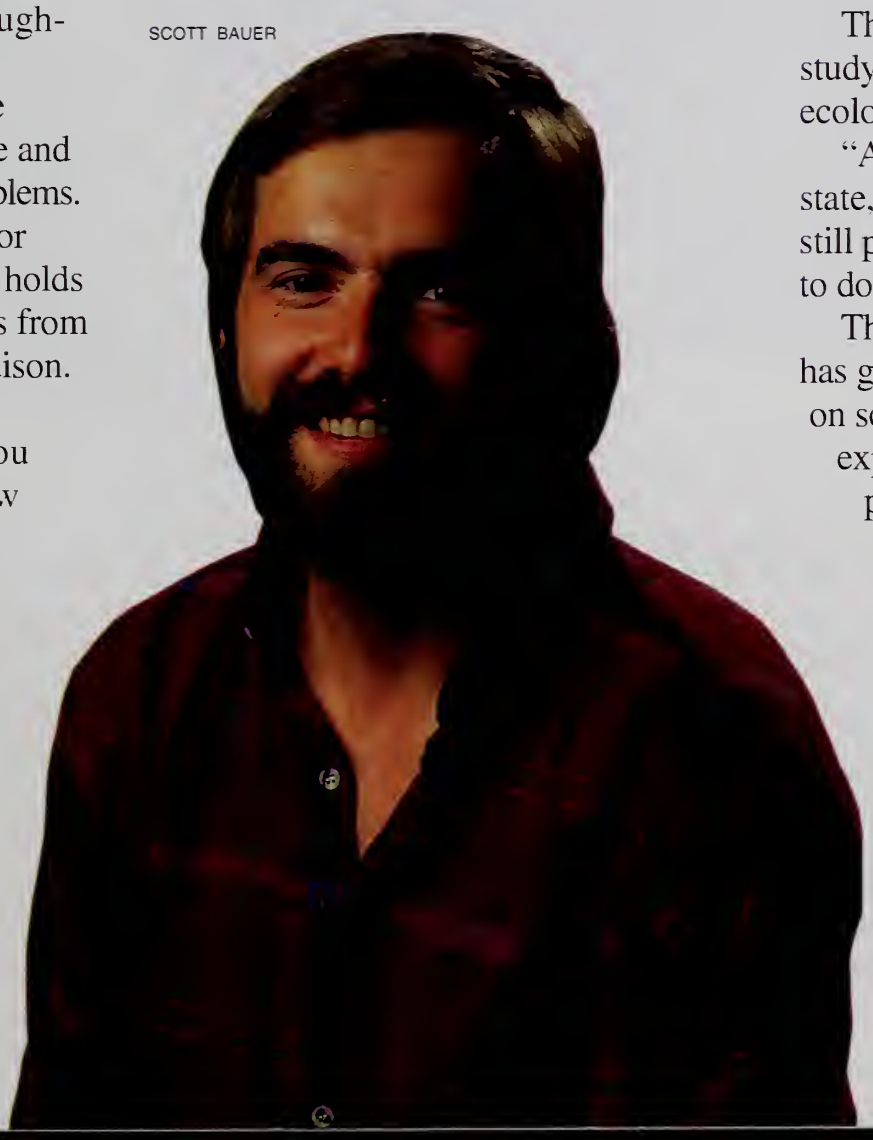


The soil samples came from field plots where the barley residue, or straw, had been either plowed under (conventional tillage) or left on the surface (conservation tillage). The latter practice is known to stop wind from eroding the soil.

"Basically, we're looking at a number of different variables that might influence the nutrient composition in soils—tillage, soil depth, temperature, for example," says Sparrow. In the Fairbanks region, the ground begins to freeze by the first of October and doesn't completely thaw until the end of June. "That means barley straw will break down much more slowly than in warmer regions."

The goal, of course, is to advise farmers how best to manage for greatest yields with least damage to the environment.

That's what appeals to Karidis—a study with a practical purpose and an ecologically sound result.

"Alaska really is a pioneering state," he points out. "Because it's still pristine up here, we have a chance to do things right, from the start."

The Teacher's Fellowship program has given Karidis a new perspective on science, says Sparrow. In fact, the experience inspired him to write a proposal for a new way to teach kids about the process of bringing food from the farm, to the supermarket, to our tables. The project would address traditional as well as modern approaches to food gathering, with input from an Eskimo teacher from Fairbanks.—By **Julie Corliss**, ARS. ◆

Willie Karidis (K-4270-3)

Watching Cholesterol—in the Lab

SCOTT BAUER

High school senior Danielle Spearman counts blood platelets at the ARS Human Nutrition Research Center in Beltsville, Maryland. (K-4205-13)

"I felt important, like I was contributing something."

> "The scientists showed me how to do the job, made sure I knew how, and then let me go at it."

There is life after high school, but will it include a career in science? To help yourself decide, consider becoming an apprentice at the Agricultural Research Service. The 8-week program won't tie you down all summer—and probably will pay at least what you'd make at the local fast-food eatery.

What do three former research apprentices say about the program?

"The scientists showed me how to do the job, made sure I knew how, and then let me go at it," says college freshman Steven Crone.

"Some programs like this you have to pay for," adds freshman Glenn Flaim.

"I felt important, like I was contributing something," says Danielle Spearman, a high school senior.

All three worked last summer at ARS' Human Nutrition Research Center in Beltsville, Maryland. They helped scientists at the center's Lipid Nutrition Laboratory.

Lipids are fats. Without them, your body couldn't store energy, produce hormones, keep cell and tissue membranes intact and supple, or perform many other functions.

But your health can suffer from a high-fat diet, especially one with too much cholesterol and saturated fat—the kind that turns solid at room temperature.

SCOTT BAUER

Research apprentice Steven Crone assists with metabolism research at the ARS Human Nutrition Research Center in Beltsville, Maryland. (K-4231-6)

What really matters, as Crone, Flaim, and Spearman learned, is what happens after fats arrive in the bloodstream in the form of fatty acids. In some people, fats tend to accumulate along artery walls. This hinders blood flow, raises blood pressure, and increases the risk that a blood clot can block an artery and cause a heart attack.

Contrary to popular belief, cholesterol isn't fat—it's a steroid alcohol molecule. It occurs naturally in animal tissues, and your body also makes it.

High blood cholesterol is often associated with high consumption of saturated fat. So eating "cholesterol-free" potato chips fried in palm oil—which is high in saturated fat—isn't going to help you watch your cholesterol.

Cholesterol circulates in the blood in two principal types of special proteins called lipoproteins. One type is the artery-clogging "bad cholesterol" or LDL, which stands for low-density lipoprotein. The other type, HDL or high-density lipoprotein, helps counteract LDL.

"You might think of LDL's as delivery trucks, depositing fatty acid esters of cholesterol in blood vessels, and HDL's as garbage trucks, taking them back to the liver where they're broken down," says ARS chemist Elliott Berlin.

He notes that earlier studies by ARS and many other researchers have established the overall value of HDL and unsaturates. But there is considerable debate on whether the risk of cardiovascular disease—as well as cancer and other health problems—can be further reduced by vitamin E. This vitamin is essential for, among other things, keeping blood flowing rather than clotting at the wrong time.

"We want to know if—and how and when—vitamin E protects fish oil's fatty acids from oxidation so that HDL containing these acids can

remove more cholesterol from the bloodstream," Berlin says.

Steven Crone, a 1991 graduate of Mount Hebron High School in Ellicott City, Maryland, majors in molecular and cell biology at Penn State University. But last summer his task was to help Berlin analyze blood samples from a human study.

During the 28-week study, 40 volunteers took all their meals at the Beltsville center. After week 10, they got a 15-gram daily supplement of fish oil. During the final 8 weeks, they also got a vitamin E supplement.

"We saw, from Steve's work on analyzing the samples, signs that vitamin E protected the unsaturated fatty acids better in some lipoproteins than in others," Berlin says. But, he adds, the findings aren't enough to prove vitamin E reduces heart disease risks.

To run the analyses, Crone learned to perform thin-layer chromatography and use a gas chromatograph and spectrophotometer. "That taught me not to be afraid of trying something new," Crone says. "I also learned to look at data critically, proofread, and make sure I'd done everything thoroughly. If it didn't look right, I redid it."

Another benefit of the apprentice program, says chemist Aldo Ferretti, is to expose students to ideas they may not encounter in school. "Teachers have so many demands on them," he says, "they often don't have time to show students where the frontiers are in science."

Plus, Ferretti adds, science is "hard work and sometimes you get dirty."

Glenn Flaim needed no introduction to those two ideas—having worked a few years as a bricklayer's helper. Last year, after graduating from Crossland High School in Temple Hills, Maryland, Flaim went to work at the Lipid lab. He helped Ferretti with different aspects of the fish oil study.

Cholesterol count is a well known risk indicator for heart disease, Ferretti notes, but "Glenn helped us examine how fish oil affects a more complex biochemical indicator."

That indicator is 11-dehydro-thromboxane B-2. It's excreted in the urine as a breakdown product of thromboxane, a quasi-hormonal substance produced in the blood. Excess thromboxane raises the risk of heart disease partly by constricting arteries.

"You can't prejudge what a situation will be like and back away. I kept thinking I'd be lonely and uncomfortable. Instead, I learned from everybody I talked to."

While too much cholesterol is like sludge clogging a hose, excess thromboxane worsens matters by making the hose narrower.

Flaim ran analyses for B-2 in purified urine samples. For the part of the study when the volunteers got fish oil, "we found a significant drop in B-2," Ferretti says. "That means the volunteers were making less thromboxane because of the fish oil. This wasn't a new finding, but it was especially meaningful because this was the largest study of its kind in humans."

He and technician Vincent Flanagan taught Flaim how to use chromatographs, mass spectrophotometers, and other laboratory tools.

Flaim, now at Prince George's County Community College in Maryland, says, "Working at ARS gave me a better basis for making the decision on whether to major in a science. Working in a lab is okay, but you might not have any results for a year. When I lay bricks, I can see results fast." Still, while he hasn't made a final decision, he's leaning toward science.

Progress can take a long time, agrees Ferretti. "Glenn should feel encouraged that he helped us add a small brick to the building of science, so it can better serve human health. And he also helped us develop a new, more specific and sensitive method for measuring the thromboxane byproduct. He was one of the first people to use it."

The method will also be used in future human studies, Ferretti adds. "We want to see the changes that fish oil and other fat sources produce in the ratio of thromboxane to its biological counterpart"—an artery-dilating quasi-hormone called prostacyclin.

"That work will be exciting, and may give us a more comprehensive view of what the body is doing than we have had before," says Ferretti.

"Science begins with curiosity," according to Danielle Spearman,

senior at LaReine High School in Suitland, Maryland.

She started out with no idea what to expect from working in a scientific lab. "I kept thinking I'd be lonely and uncomfortable." But the experience taught her differently: "You can't prejudge what a situation will be like and back away. Instead, I learned from everybody I talked to."

Her openness and determination will pay off, especially if she pursues her interest in engineering—a field with few black women today.

In a way, working with a research team was similar to something Spearman has been doing for several years. She sings alto in a choir that's performed at Constitution Hall in Washington, D.C., and many other places.

Singing, she knows from experience, calls for discipline, dedication, and hard work spanning many more hours than a concert performance. That's not unlike the long labor on a science experiment that "performs" in public as a journal report.

At ARS, Spearman helped chemist Norberta Schoene analyze results of a study conducted because an intriguing finding turned up in the fish oil experiment.

"The fish oil," Schoene says, "reduced the overall average volume of the volunteers' blood platelets, but the numbers of platelets remained the same."

Platelets, normally flat discs, swell to spheres as a first step in becoming activated to stop bleeding. When many spheres send out spikes that interlock with each other, clumps or aggregates form to make the blood coagulate. But abnormal activation may cause unwanted coagulation. That can restrict blood flow—a common problem in diabetics and people with heart disease.

"If," she says, "fish oil reduces platelet volume but not the total platelet count, it suggests that more of the platelets stayed disc-like."

SCOTT BAUER

ARS chemist Aldo Ferretti and research apprentice Glenn Flaim perform a gas chromatograph-mass spectrometer analysis at the ARS Human Nutrition Research Center in Beltsville, Maryland. (K-4205-2)

While fish oil is already known to reduce activation, platelet volume may be a more precise indicator. Schoene cautions that this possibility has to be carefully investigated. "We first need a method to measure volume that will be accurate, reliable, and reproducible," she says. "The reading varies depending on how long a sample sits and which anticoagulant is added to the sample to keep it from turning to jelly."

To help Schoene identify the best anticoagulant and timing, Spearman ran blood samples—which the scientist had drawn from laboratory rats—through a cell counter. This high-tech instrument counts and sizes the platelets.

Spearman transmitted the counter's data to a computer and used software to graph the results so Schoene could analyze them.

Armed with the findings, Schoene can now plan new studies on how dietary fats affect platelet volume in both laboratory animals and human volunteers. One day, the results could help nutritionists and physicians design more healthful diets, especially for people at higher risk of heart disease, diabetes, and other ailments.

"It took a while to believe I was being so trusted," Spearman recalls, "but I knew Dr. Schoene depended on me to make correct calculations."

For the singer-student, this trust may have wrapped some harmony around the cold staccato notes of data. "When you work around science," Spearman muses, "you learn how many things there are to think about in this world."—By **Jim De Quattro,** ARS. ◆

Agriculture Research Brings Big Opportunities

"I can't believe I'm gettin' paid to do this!" Dana Daniels' soft southern drawl is as incredulous as her excitement is contagious.

"Can you imagine? I actually helped create an almost-perfect plant." She is talking about using tissue culture to produce disease-free strawberry plants.

In a sleepy little southern town of 2,500 where economic security comes from manufacturing nightgowns and bluejeans, how could an 18-year-old high school senior have such an opportunity?

No Pizza Hut, no Hardees—the town can't even boast of a McDonalds.

But Poplarville, Mississippi, is home to the ARS Small Fruit Research Station. And because of its Research Apprenticeship Program, Dana Daniels is able to participate in exciting new research on plant diseases.

Daniels ranked number one in Poplarville High School's 84-member class of 1991 and now attends Pearl River Community College in Poplarville.

"This makes 2 years I've worked for ARS," Daniels continues. "Barbara Smith makes the work seem so easy."

She's speaking of the plant pathologist who has guided Daniels through the tissue culture work. Together they have also inoculated blackberries with a fungus that causes rosette, a serious disease of blackberries in the Southeast.

"One of the best feelings I've ever had was when I came back to the lab this year and saw that some of the plants I put in tissue culture last summer had borne brand new plants. Now those plants are just about ready to fruit," Daniels says.

And she is very much interested in new births. Daniels plans to be a pediatrician, specializing in allergies.

Although she knows she has a long academic road ahead, Daniels feels that she will succeed. "I've learned discipline here in this lab. I understand that research takes a lot of effort, and I've also learned that it sometimes takes a lot of time to get results."

Education and hard work are encouraged by Daniels' parents, both teachers in the local school system, and by her older sister who is entering her first year of graduate work at the University of Southern Mississippi.

"We'd certainly like to have Dana back this summer," Smith says. "We inoculated blackberry plants with the rosette fungus to see if summer temperatures would affect the disease. The plants should start expressing symptoms of the disease in late spring. So by the time school is out, we'll be ready to continue our study of how temperatures affect this disease."

Smith says she was very pleased with the interest Daniels took in her work. "In fact, if we want to interest our bright young people in agricultural science, the Research Apprenticeship Program is the way to go."

Many miles and a couple of states away, teacher Michelle Dyal of Byron, Georgia, is also enjoying hands-on research.

Like Poplarville, Byron is a small town. One of its major distinctions is the ARS Southeastern Fruit and Tree Nut Research Laboratory.

"One of my colleagues here at Northside High told me about the Teachers Fellowship Program available at the ARS lab in Byron," Dyal says. She teaches chemistry and biology at the Warner Robins, Georgia, high school that enrolls about 1,600 students.

"Working at the ARS lab was my first exposure to applied research," Dyal explains. "In college, most of my classes were geared toward education and teaching. So even

ROB FLYNN

o Small Towns

though I took science courses, I hadn't done any actual research."

Teachers, she says, are taught to present scientific methods step by step by step. In theory it all sounded so methodical and orderly, Dyal says. "But I learned at the Byron lab what 'variables' in research really mean."

She found that "weather can play havoc with a research project, and too little sun or even a rain shower can drastically alter research results."

"I think I'm a better teacher as a result of my participating in scientific research," she continues.

"We had been thinking for some time about spraying pecan plants with common agricultural and household detergents and soaps to control aphids," says Byron's acting research leader Bruce W. Wood.

"Since home gardeners use these types of sprays effectively, we thought we'd test them on an orchard crop."

I think I'm a better teacher as a result of participating in scientific research.

Wood hired Dyal to begin this particular research project.

He says there has been a movement for some time among pecan growers to reduce the use of insecticides. At the same time, they needed to keep the harmful insect populations below economic levels. Detergents can do that. But one of the problems with using soaps and

Florida science teachers (left to right) Mary Louise Grable, Claudia Walls, Kim Ruhle Paschall, and Judy Smith, working for the Agricultural Research Service in the Teacher Fellowship Program. (K-4563-19)

ROB FLYNN

Apopka High School science teacher Claudia Walls examines a citrus graft in an ARS greenhouse. (K-4565-12)

ROB FLYNN

Attaching thermocouples in a cold room, science teacher Mary Louise Grable helps with studies on citrus freeze resistance at ARS' Horticultural Research Laboratory in Orlando, Florida. (K-4566-1)

detergents, Wood explains, is that they can reduce photosynthesis.

They can apparently strip off the leaf's cuticle, leaving the exposed leaf vulnerable. In addition to agricultural detergents, Dyal experimented with common household soaps and detergents like Ivory, Cheer, and Tide.

"Ms. Dyal showed that some of the soaps killed pecan aphids without harming the plants or the beneficial insects or affecting the rate of photosynthesis," Wood comments. "She began the initial work, and we're hoping to hire her back this summer to continue the research."

He thinks that the project will be ready for publication in another year or so. And a certain science teacher may be well on her way to her very first research publication.

Administrators at the Georgia College in Milledgeville, Georgia, where Dyal is working on her masters degree, are impressed with her work. In fact, they are allowing her 10 quarter hours' credit toward the degree for her summer with ARS.

The Teachers Fellowship program is funded in part by the ARS Area offices. Research priorities determine where closely budgeted dollars must go.

Orlando, Florida, also links its classrooms to the real world of research. And George Yelenosky is the link between Orange County, Florida, science teachers and researchers at the ARS Horticultural Research Laboratory.

An ARS plant physiologist, Yelenosky has served as mentor to county science teachers for 3 years. Selected teachers spend 2 weeks at the lab where they get practical experience in all aspects of citrus research.

"When I came to the ARS lab, I knew absolutely nothing about growing citrus," says Judith D. Smith. "Dr. Yelenosky taught me so much. It

ROB FLYNN

Evans High School science teacher Judy Smith draws a sample of citrus plant cells. (K-4564-2)

wasn't just a lecture—I actually grafted citrus. Also, I can now explain to my students what biocontrol really means."

Smith teaches 9th and 10th grade science honors students at Evans High School in Orlando.

Before teaching biology at Dr. Phillips High School, Mary Louise Grable spent most of her career in hospital laboratories performing medical research. Agricultural science is an entirely new field to her.

"My reason for applying for this program," she says, "was to expand my own knowledge and ultimately that of my students. I felt this to be an unbelievable opportunity for better communications between those who teach science and those who apply science."

Grable says she now uses ARS researchers as resources. "Also, the Orlando lab has the best research library I've seen. I'm requiring my students to write research articles, and they are learning their way around the ARS library."

And it's not just high school students who benefit from this program. Sixth graders at Orlando's Southwest Middle School are in for an intense science experience.

After science teacher Kim Ruhle Paschall spent time at the ARS lab, she co-sponsored a seminar on teaching techniques. The program description reflects the influence of lab lingo: "Growing, culturing, grafting, and nurturing budding scientists for a future harvest."

Claudia Walls, who co-sponsored the seminar, teaches biology at the Apopka High School.

"Apopka is like the plant capital of the world. Sometimes potential high school dropouts in this area think they'll be able to make a living by working in nurseries. They think they won't need much of an education to get by," she says. "My time with the ARS lab clearly demonstrated the error of this thinking. I now tell my students: if you want to work in a nursery, you must be trained in modern computer technology. There is much more to modern nurseries than just digging a hole and putting a plant in the ground."

This insight, she says, came from the day she spent at Foundation Farm near Leesburg, Florida, where ARS Orlando researchers use many kinds of scientific equipment and technology to plant and maintain their experimental research plots.

The Industry Study Program, sponsored by the Florida State Department of Education's Summer Science Institute, is touted as a partnership between the Orange County school system and science-related business or industry. The interaction brings the entire community closer together, promoting strong professional ties between industry and educators.

The four teachers who participated in the program at the Orlando ARS lab received credit toward their teaching recertification.—By **Doris Stanley,** ARS. ◆

ROB FLYNN

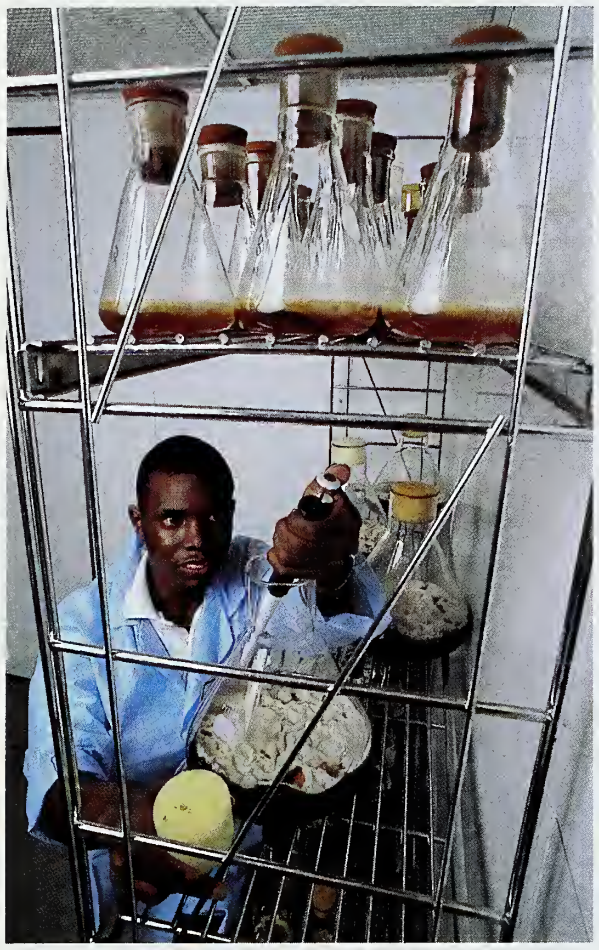
In a pecan orchard at the Southeastern Fruit and Tree Nut Research Laboratory in Byron, Georgia, science teacher Michelle Dyal takes a photosynthesis reading. (K-4567-1)

ROB FLYNN

Plant physiologist George Yelenosky records data as Kim Ruhle Paschall, a science teacher at Orlando's Southwest Middle School, measures citrus fruit diameters. (K-4563-14)

Partners With the Public Schools

SCOTT BAUER



John F. Kennedy High School student Velton Welch collects a sample of a fungal culture at the ARS Southern Regional Research Center in New Orleans. (K-4475-3)

As principal of John F. Kennedy High School in New Orleans, Anita Dumas likes to think she has the educational equivalent to a Louisiana oil well right in her own back yard.

"For a number of years, 8 to 10 now, Kennedy has been trying to establish a math-science academy, but there's never been adequate funding," Dumas says. "Nevertheless, Kennedy has a reputation for stressing math and sciences."

At a time when educators throughout Louisiana scrap for tightly-clenched dollars, Dumas has successfully tapped the resources of a neighboring institution, the Agricultural Research Service.

JFK students couldn't pay for the education they've received from the school's partnership with ARS, Dumas says. "Where else could you have one-on-one contact with scientists?"

"We have been a New Orleans public schools' partner in education for several years," says Alan R. Lax, plant physiologist and community education coordinator at ARS' Southern Regional Research Center (SRRC). "Our student mentor program was established as an offshoot of this partnership."

Dumas, however, wasn't al-together unfamiliar with the New Orleans center. Several teachers at JFK had participated in the agency's Teacher's Research Fellowship Program.

One of those to go through the teacher's program was designated by Dumas to spearhead the student program between the center and school.

"From my experience, I was able to relate to students what type of work I did and how important it was doing research work," says Lemona Chandler, a chemistry and biology teacher. "To me, this program is an opportunity for students to actually work alongside a scientist."

"Many of my students were enthusiastic. They always read about scientists and researchers, but they never really see an actual research scientist working," she adds.

In the 1989-90 school year, John A. Barkate, director of the New Orleans center, and Dumas tested the program by giving 10 JFK students a chance to work in microbiology, chemistry, and biology with federal researchers. Chandler periodically checked on those students' progress with the participating SRRC scientists.

"Shortly after I became director of this center, I visited with Dr. Dumas to introduce myself and determine how we could help each other as neighbors," Barkate recalls. "We soon arranged for SRRC scientists to give presentations to the various science classes at John F. Kennedy and provide tours of the center.

"We wanted to make teachers and students more aware of the scientific talent and facilities at SRRC," he adds. "This led to the idea that these students could benefit from spending some time working with a scientist at the center, a mentor who could encourage some of them to pursue science as a career."

As word of the mentor program spread through the halls and classrooms of JFK High, competition for an expanded 12-student program in the second year was fierce.

"We got more than the number we needed. Enough that we had to turn students away," Dumas says.

Now in its third year, the school's mentor program with SRRC has expanded from its 1-hour-a-day format to 3 hours. Chandler says the students involved in this year's expanded program are facing more responsibility by working on their own research projects, with SRRC scientists providing technical assistance.

"Each will have to make a presentation of a specific project, in writing as

"Where else could you have one-on-one contact with scientists?"

SCOTT BAUER

ARS lab technician Debra Williams and Kennedy high school student Sean Gros label cotton bolls for identification. (K-4477-2)

well as orally, just like professional scientists do," Chandler says.

Angela Archer, 17, is working in SRRC's Food Flavor Quality Research Unit on compiling and translating research results via computer. Ultimately, Angela hopes to set up a computer program that gives scientists ready access to a bank of information needed to reach conclusions on various experiments.

"I was going into medicine first, but now I think I'll be going into computer sciences," says Angela, who plans to attend Xavier University of Louisiana in New Orleans next year.

"This isn't a class you can goof off in. You have to have a good mind, you have to be a good student." she adds. "The 3 hours each day helps you get a lot more done and you learn a lot more."

Scientist Alan Lax says the only expense to ARS to run the mentor program is researcher time. He considers the program an investment in ARS' future by encouraging students early to choose a career in agricultural sciences.

"It's really a recruiting tool to increase student awareness of opportunities within USDA and ARS," Lax says. "While the program is in its infancy, I think we've opened eyes for potential employment in the agency."

Chandler remembers a past student who was so enthusiastic when the program ended that he reported, "I want to come back from college and work here again."

Although the program is limited to seniors, Dumas says the experiences gained by these students has rubbed off throughout the entire JFK student body.

"By working at SRRC they are able to come back to the classroom and tell other students about what they are doing," Chandler says. "They keep a log on the experiments they run so they're able to share this with other students."

The SRRC/JFK program is also giving high school students a jump on college, says 17-year-old Velton Welch. Along with SRRC geneticist Hurley Shepherd, Welch is studying the production rate of natural toxins in different strains of fungi isolated from cotton seed at the center's Environmental Technology Research Unit.

"By working here at the lab, I think I'll get a good background in the scientific terminology," says Welch, who hopes to attend the Tuskegee Institute in Alabama. "In this program you get to see what you're doing, instead of reading about it in a book."

Chandler also keeps track of mentor students once they go to college. She says the number of students who later pursue science careers in college is an objective measurement of the program's success.—By **Bruce Kinzel**, ARS. ◆

SCOTT BAUER

Chemist Casey Grimm prepares samples of peanut butter for aroma evaluation by Kennedy student Angela Archer. (K-4467-1)

BRUCE FRITZ

At the National Center for Agricultural Utilization Research, middle school student Jenni Hermacinski helps with an experiment on biological control of insects. (K-4540-5)

Adopt a School

Enrich a Student

In praise of a program that's ideal for middle school students.

Alijah Griffin, who always thought he wanted to be a doctor or maybe a lawyer, is now thinking about being a scientist.

Jenni Hermacinski's eyes light up as she describes the day she spent learning about parasites.

At Calvin Coolidge Middle School in Peoria, Illinois, students are getting a unique look at the world of science, now that the school has been adopted by ARS' National Center for Agricultural Utilization Research (NCAUR).

The Peoria Area Chamber of Commerce, in cooperation with Peoria Public School District 150, sponsors an Adopt-a-School program. The purpose is to use the expertise of the business community to enrich and improve the education of public school students in Peoria.

"The emphasis here is on the sharing of human resources," says Billie Block, Chamber of Commerce coordinator of the program. "We also believe that the program will help the community gain a better understanding of the public school system."

The center became interested through the Midwest Area Equal Employment Opportunity committee.

"I was aware of the Adopt-a-School program from reading about it in the newspaper," explains Susan P. McCormick, a scientist in the Mycotoxin Research Unit and now the program's coordinator, "but it was Darwin Murrell, ARS Midwest Area director, who decided that NCAUR should become involved."

The center was matched with Calvin Coolidge Middle School and officially adopted the school in October 1990.

When the new school year began last August, ARS scientists were ready to once again adopt the youngsters.

"We think that middle school students are ideal for our program," McCormick says. "They're at an age when science can really make an impression."

Science teachers at the school and McCormick plan activities for the school year. After studying the school's science textbooks, McCormick matches researchers with the classroom studies.

Scientists visit the school throughout the year to give presentations and demonstrations about everything from microscopes to superslurper, a starch-based product developed at NCAUR.

At the end of the 1990-91 school year, a dozen of the school's fifth through eighth grade students spent a day at the center. Paired with a mentor, the students conducted their own research or assisted with a project. The same type of program highlights the 1991-92 school year.

"We select the students who are the most enthusiastic about science, the ones we think will benefit the most from an experience that allows them to see how science applies to the world," explains science teacher Susan Grzanich.

Twelve-year-old Jenni Hermacinski has always liked her science classes, but she hadn't given much thought to a career in science.

"Going to the lab made me think about what I want to be when I grow up," she said. "Learning about parasites was interesting."

The Adopt-a-School program, especially the trip to NCAUR, has changed Griffin's feelings about science. He recalls visits from scientists who talked about plants, soil, and cooking oil.

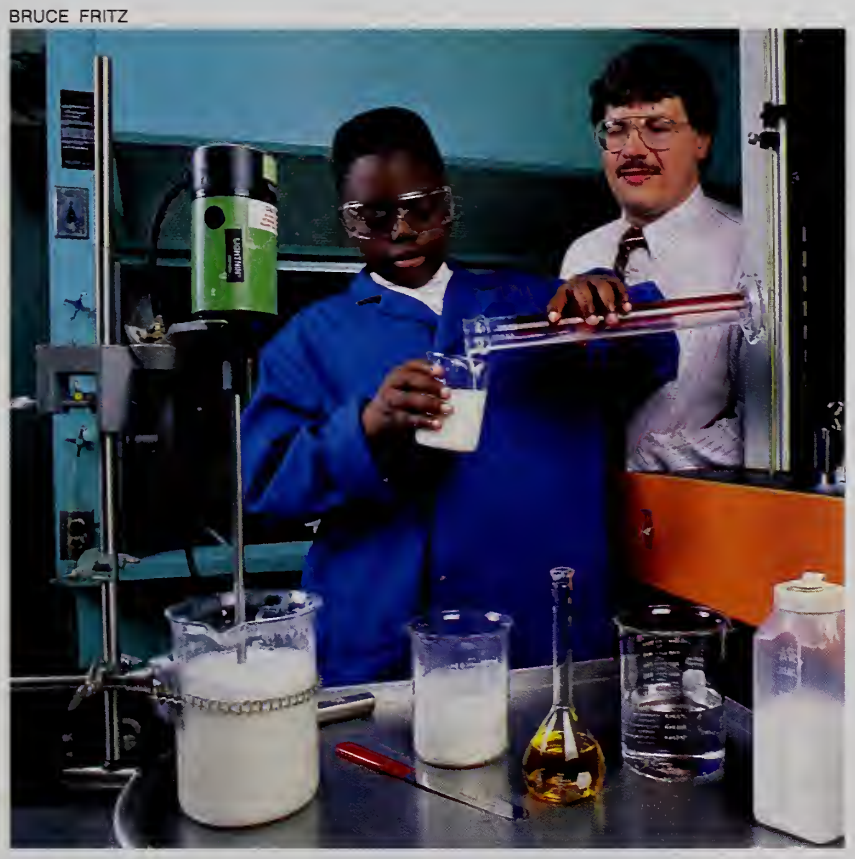
"I really liked going to the lab to see what goes on there," he says.

The laboratory visit was as much a treat for the scientists as it was the children, say mentors Subhash C. Gupta and Timothy D. Leathers.

"I get a lot of satisfaction telling the students about our work," says Gupta. "I really enjoy having the kids here and teaching them a little about science." Gupta and Leathers are researching biological control of insects through the use of fungi.

"Spending a day telling a student about our work, in terms they can understand, helps put our work in perspective," says Leathers. "I think we wind up understanding it better ourselves."—By **Marcie Gerrietts,** ARS. ◆

BRUCE FRITZ



Under the Adopt-a-School Program, student Alijha Griffin (left) helps ARS technician Steven Lyle test a milk beverage developed at the NCAUR. (K-4539-1)

Turn 'Em On to Science, Turn 'Em Into Scientists!

Remember Tom Sawyer's scheme to get out of white-washing his aunt's fence?

Though he despised the assignment, the young manipulator set to work on the fence with gusto, stepping back to admire his work just as other children walked by. Entranced by the fun Tom seemed to be having, Tom persuaded the others that they should pay for the pleasure of sharing the fun.

Today in Montana, scientists and weed experts are teaming up to make science interesting enough so students will want to work in agriculture and major in agricultural sciences.

"Our goal is to expose young folks to agricultural problems, and through hands-on experiences, let them learn how to manage them. This should excite some to go on and major in agricultural science. We need science majors who will build on our work and accomplish even more," says Chuck Egan, county extension agent in Stillwater County, Montana.

"While we don't expect all of our students to become weed scientists, entomologists, or even agriculture majors, we hope they will find science as fascinating as we do. That should encourage more of them to major in some scientific field," says Agricultural Research Service entomologist Norm Rees.

Egan, Rees, and Wayne Pearson, Stillwater County weed agent, cooperated in developing a science program to educate students.

With this unique project, students learn about science while conducting research and attempting to control leafy spurge, a noxious weed that is already ranked as one of the worst in the Northern Great Plains and Canada and that is threatening an even larger area. It has now appeared as far south as Arizona and New Mexico. The area occupied by leafy spurge is estimated to be enlarging by about 10 percent each year, thus doubling the area it infests about every 7 years.

Just for the Fun of It

Rees, who works at ARS' Biological Control of Weeds Research Unit at the Rangeland Weeds Laboratory in Bozeman, Montana, starts his three-part training with a course entitled "Entomology for the Fun of It." "It covers the lighter side of entomology by explaining why insects are more than just squishy bugs—why you don't need to fear insects—how to understand their lifestyles. Students also learn how to identify a few of the 5,000 to 50,000 insect species found in a typical backyard.

The second phase of the course explains the delicate balance of how insects and plants interact and why attempts to control weeds with insects succeed or fail. Some insects kill other insects and spare the plant from feeding injury or from disease organisms that insects transport. Other beneficial insects feed on plants that are noxious.

NORM REES

At a research site near Columbus, Montana, ARS biological technician Kimberly Mann (right) instructs science project teachers and students in plant sampling and identification.

The third part of the training allows students to conduct their own experiments, putting biocontrol to work: finding which insects are best at eating leafy spurge, how they affect the weed, and how several beneficial species interrelate.

Spurge produces a poisonous milky-white latex that looks and feels like white glue. People who pull or cut leafy spurge must make sure to wash their hands because the poisons can irritate their eyes and other sensitive body tissue. Cattle that graze the plant develop blisters in the esophagus.

No known approved herbicide has been reported to kill 3-year-old and older spurge patches. Leafy spurge is so tough, it can spring to life after 7 years of seed dormancy in soil treated with a soil sterilant.

Leafy spurge first came to this country at least 200 years ago. It was most likely accidentally mixed with crop seeds that early settlers brought from Europe and Asia and in ballast that stabilized their ships. Many closely related but distinctly different biotypes of leafy spurge originated in different parts of Eurasia, and these strains may have crossbred in the United States to produce an even greater variety to combat.

The key to controlling leafy spurge in this country is importing insects and diseases from the native land of spurges to infest the various leafy spurge types. It is not a problem weed in its native lands, where it falls prey to insects and diseases.

These insects are carefully tested to make sure they can survive on only leafy spurge but not on valuable crop plants or native plant species of North

NORM REES

Vocational ag instructor Jim Larson and Columbus High School student Ben Larson examine weeds that are being controlled by a flea beetle species imported from Italy.

America. When leafy spurge populations become reduced, so will the number of controlling insects and diseases.

Three high schools in Park City, Columbus, and Absarokee are currently involved.

"Growing up in a farming community, we learned to hate insects because they destroy crops and sting cattle. After taking the course, I now see bugs completely different. They really do more good than harm," says Thad Daniels, a sophomore at Columbus High School. Daniels says he hopes to learn more about entomology.

By the time the students complete the project, they will know how to use a research library, conduct literature searches, perform the research, analyze the data, write technical papers, and present findings to groups such as the Montana Weed Control Association. They will essentially have conducted a mini-masters program before even entering college.

"The students are getting an opportunity to study insects and integrated pest management in depth," says Jim Larson, vocational agriculture instructor at Columbus High. He says the program is excellent, and he hopes it will help foster a greater appreciation for agrisciences.

"The students find the program interesting because they are learning about science while solving problems in their own community," says Tina Lynch, a participating teacher at Park City.

Students are assigned to areas that have been fenced to keep grazing wildlife and cattle from disturbing the experiment and eating leafy spurge plants. Students will count plants and study the insect populations to learn how they multiply in their new environment and record how much damage each species inflicts on spurge.

Students will also learn which soils, plant communities, and weather conditions favor the insects.

Weed control officials in Texas and Washington have heard of the project and have asked the group for advice in establishing similar projects in their states.—By **Dennis Senft,** ARS. ◆

A Little Help From Their Friends

SCOTT BAUER

Biologist Peter Cooke explains the use of a transmission electron microscope to honor students (L-R) Conor Davis, Anne Hoffman, and Andrew Shieh. (K-4112-1)

And we're facing a dilemma: Where are we going to get our future scientists?

Erica Salaman didn't have access to technical information of how thiamin affects plants. Although she combed local universities and companies, the precocious eighth grader felt her inquiries had fallen on deaf ears.

"Finally I contacted ARS' Eastern Regional Research Center in Philadelphia and they suggested I talk with Dr. Nagahashi," Erica says of George Nagahashi, a chemist at the center's Plant Soil Biophysics Research Unit. "He gave me some hints and mailed some articles on thiamine and its relationship with plants."

Today Erica, a senior at Philadelphia's George Washington High School, works part-time at the Philadelphia center, where she is tracing the movement of vitamins through plants.

The Philadelphia high school student is one of 19 area students recently honored by the center who chose agriculture-related science projects for the Delaware Valley Science Fairs. The annual event is held at Pennsylvania State University's Ogontz campus.

The science fair attracted more than 700 projects from students in southeastern Pennsylvania, southern New Jersey, and northern Delaware. Last year was the inaugural year of a program initiated by the Philadelphia center designed to stimulate student interest in agriculture-related sciences.

In fact, six researchers from the Philadelphia center volunteered to judge projects at the regional science fair. One of those judges—chemist Michael H. Tunick—recommended the program honoring the students to the center's director, John P. Cherry.

"I was wondering what I could do to help students along in the field of science," Tunick recalls.

Cherry was receptive to Tunick's idea. "We are science," Cherry told the students at last year's ceremony, "and we're facing a dilemma: Where are we going to get our future scientists?

"There is a career in science, and that career can be with the Agricultural Research Service," he added. "I'm hoping that many of you might grow up and come to work for us. We have to solve problems to make the ways in American life better. ARS is more than plants and animals. We're into projects like food safety and product development."

For example, scientists at the Philadelphia center developed instant potato flakes, made phosphate-free laundry detergents from tallow (beef or sheep fat), and evaluated ways of enhancing the aroma of jellies, fruit drinks, candies, and frozen desserts. ARS research has also helped improve the environment and develop alternative fuels.

"How many of you in here today are wearing leather shoes?" he asked. As a number of hands rose in acknowledgment, Cherry explained how research from the Philadelphia center was responsible for the flexible qualities in leather shoes and clothing.

Chris Dominello, a senior at Bishop McDevitt High School in suburban Philadelphia, says that he hadn't realized that his science project on nonchemical attractants for fruit flies was related to agriculture until he toured the 375,000-square-foot facility.

"I thought I was going to see cows and farms and not anything that was really high tech," he says. "It was a great opportunity to see what agriculture is really like."

Most students were in agreement on the basic importance of agricultural research.

"Agriculture is the basis for everything in life," says Andrew Shieh, a 10th grader at Upper Dublin High School in Fort Washington, Pennsylvania. "You can't do anything else in life without food."

And one student, Sharon O'Brien of Archbishop Wood High School in Warminster, Pennsylvania, already has her sights on a career in agricultural science because "it is something that will never be outdated." Sharon's project tracked the pH level in milk as its temperature changes.

The program also gave Cherry an opportunity to explain to students how the Philadelphia center can assist in furthering their science education, either in high school or in college, through its summer or part-time job programs.

As for former eighth grader, Erica Salaman, she views her current part-time job at the Plant Soil and Biophysics Research Unit as an investment in her education. She thinks that learning to use analytic equipment and interacting with ARS scientists will give her an advantage when she heads for college next year.

"Working here is a job, but my paycheck isn't my only gain," she says. "I'll hopefully publish once or twice before I go to college."—By **Bruce Kinzel,** ARS. ◆

SCOTT BAUER

At the Eastern Regional Research Center, chemist Ed Piotrowski explains the use of robotics in high volume testing to students Tom Greshock (center) and Paul Hrynko (right). (K-4110-12)

SCOTT BAUER

Washington High School senior Erica Salaman explains the details of her science project to ARS chemists Michael Tunick and Jay Fox. (K-4111-6)

Winning With Val-Sal

DAVID NANCE

Top: Booneville, Arkansas high school students Tracy Whitehead and Brandon Barnard laugh about a less-than-glamorous aspect of horn fly research. (K-4561-4)

Bottom: In the VAL/SAL program, Brandon Barnard and Tracy Whitehead use a near-infrared spectrophotometer to measure protein in forage. (K-4561-8)

Brandon Barnard doubts he'll ever forget his summer with Mississippi.

Not in Mississippi the state; with Mississippi the bull, 2,400 pounds of Brahman brawn, with a deceptively intimidating glare that could make a newcomer feel chills even on a steamy summer afternoon in Arkansas.

Barnard, co-valedictorian of the Class of '91 at Booneville High School in Booneville, Arkansas, met Mississippi through the Agricultural Research Service's Valedictorian-Salutatorian Program, commonly known as Val-Sal.

This program offers full-time summer employment at ARS research facilities to valedictorians and salutatorians of local high schools. Regardless of whether these high-achieving students accept the job offers, they receive a certificate of appreciation from ARS for their academic diligence.

Started in 1989 as a pilot project in ARS' Southern Plains Area, which includes Arkansas, Oklahoma, Texas, and New Mexico, Val-Sal is now available throughout the agency.

"If a student has the basic drive to do well in high school, he or she already has one component we need in ARS," explains Floyd P. Horn, Southern Plains area director and initiator of the program.

"That demonstrated accomplishment is of special interest to us," Horn says. "This could help fill the gap in scientists and engineers that this country appears to be facing in the coming century."

When 18-year-old Brandon Barnard reported for work at the ARS South Central Family Farms Research Center at Booneville last June, "that first day I was expecting to get a tour and meet a lot of people," he recalls.

Instead, research leader Michael A. Brown immediately started Barnard and co-worker Tracy Whitehead, the Booneville High salutatorian, on making mysterious little wire cages.

Neither Barnard nor Whitehead knew the purpose of the little cages—but they soon found out.

"Right away, we met the animals, found out what they...did...and collected it," Barnard relates.

The youngsters' job, in simple terms, was to follow beef cattle until the animals defecated, wait 15 minutes to give pesky horn flies a chance to move in and lay eggs in the feces, then collect the feces in the little cages.

"The wire would keep any insects from getting in or out," says Whitehead. "We'd keep the enclosed feces in a greenhouse for a week, then check it for horn fly larvae."

While the work was hardly glamorous, the findings were important: determining whether the feces of cattle grazing certain types of grass, such as fescue infected with a fungus, is less hospitable to developing horn fly larvae. The results could offer important clues to controlling this major pest of grazing cattle.

Mississippi the bull, with his "mean stare," was only one of the memorable denizens of the pasture.

"There was Mountain Dew, a Brahman yearling," says Whitehead. "She was fiery, but she could be funny, too. We were following these cattle as closely as you get without them running away."

As the days passed, the students quickly became comfortable with the cattle as they learned that beneath those intimidating exteriors lurked fairly docile personalities. Other

facets of the job, however, required more adjustment.

"Working with the cow patties was really the hardest thing to get used to," Whitehead says. "I've got the cleanest hands in town, because I'm always washing them."

The students' duties went beyond collecting cow manure. Researchers at the Booneville lab also regularly milked the Brahman, Angus, and crossbred cows to check differences in milk production depending on the type of forage grazed.

The students weighed the milk, homogenized it, and shipped it away for milkfat and protein analysis. In addition, they collected grass samples to undergo near-infrared analysis for protein content.

Now studying for a degree in pharmacology at the University of Central Arkansas at Conway, Whitehead says her summer with ARS was an important learning experience.

"Until I began working with ARS, the closest I'd ever been to agriculture was when my dad planted a garden," adds Barnard, now studying business administration and religion at Ouachita Baptist University at Arkadelphia, Arkansas. "I learned a lot from my job at Booneville, and I want to try to apply what I've learned to life."

While Whitehead and Barnard worked for ARS only through the summer, fellow Val-Sal participant Stacy Kindt of Bryan, Texas, is still at work at ARS' Food Animal Protection Research Laboratory at College Station, Texas, as a part-time biological aide.

Kindt, 18, was valedictorian of the Bryan High School Class of '91 and is now attending Texas A&M University as an economics major.

Her duties at ARS entail helping scientists try to crack the code of brain chemicals called neuropeptides in various pest insects. These researchers hope to find some way to use altered versions of the neuropeptides as a more environmentally safe means of controlling specific insects.

Kindt works with research entomologist Shirlee M. Meola. She has learned the intricacies of tissue preparation to help Meola visualize the location of peptides throughout the insect's nervous system.

"I prepare slides of serial sections of mosquitoes, cockroaches, and flies," says Kindt. "I also develop film and print pictures.

"Slicing up bugs wasn't that pleasant at first," she admits. "Also, I've been down to see the roach colony; you open up the case and all the roaches start running around. And these are pretty big ones!"

Still, "I am doing more than just making money," she adds. "I am learning a lot about basic research and how it can be applied in the attempt to develop new methods of insect control, and I feel I am doing some good with my work."

"Part of the rationale of the Valedictorian-Salutatorian program is to find someone to run the store when we've retired," says Michael Brown, the research leader at the Booneville facility. "The program hasn't been in operation for very many years, but even so, I think it's already a success."—By **Sandy Miller Hays,** ARS. ◆

ARS entomologist Shirlee Meola, with Stacy Kindt looking on, examines sections of insect tissue. (K-4541-1)

VAL/SAL students from the Southern Plains Area tour the ARS Childrens' Nutrition Research Center in Houston, Texas. (K-4559-16)

"SEED" for Tomorrow

SCOTT BAUER

High school senior Georgi Hall examines a genetically engineered hybrid potato/ cape gooseberry at the Western Regional Research Center. (K-4268-13)

"I enjoy science but I don't know why," admits high school senior Georgi Hall of Richmond, California. "Maybe it's because I feel powerful when I'm a scientist, like I'm doing something important for mankind. And I really felt like a scientist when I was working at ARS."

For 10 weeks last summer, Hall aided geneticist Judith Eash and others at the ARS Western Regional Research Center, Albany, California. They experimented with a new way to protect tomatoes and potatoes from the two crops' worst insect enemies.

For Hall, the Albany job meant having his own desk and access to a computer, plus the chance to design his own experiments and "to talk with scientists who took time to work with me." Hall's biology and chemistry teachers at Richmond's Kennedy High School recommended him for the slot. "Of the projects offered to me at Albany," Hall says, "I chose the insect work because it interested me the most."

Eash, team leader Anthony Waiss, and others intend to crossbreed tomatoes or potatoes with cape gooseberry—a distant relative. Unlike tomato and potato plants, cape gooseberry's leaves contain natural compounds that kill insect pests such as the tomato fruitworm within a few days. A specialty crop, cape gooseberry yields fruit that look somewhat like orange cherry tomatoes.

The team is relying on a technique called protoplast fusion to move the insect-resistance trait, explains Eash. Fusion requires zapping cells from cape gooseberry and tomato or potato leaves with electricity. Ideally, the jolt opens cell walls just long enough for genetic material from the tomato or potato plant to mingle with that of the cape gooseberry.

Hall's job included meticulously nurturing petri dishes full of the electro-shocked cells. He prepared gel-like batches of nutrients that the cells needed for survival. Then, as cells developed, he learned how to carefully scrape off newly formed buds and move them to other petri dishes. "When the buds started producing little leaves, I'd move them into test tubes or jars and keep records of each plantlet."

Later, Hall helped dozens of plantlets survive the move from their protected life in laboratory test tubes to greenhouse pots. "It's a big shock for them to come into the outside world," he says, "but once they got stronger, I measured them, took pictures, and wrote up my observations of their characteristics."

Other tests will reveal which of the plants are true hybrids, that is, a cross of the cape gooseberry to tomato or cape gooseberry to potato. Related experiments will measure the new plants' resistance to hungry insects.

Hall is one of the dozens of college-bound minority teens that Western Regional Research Center scientists such as Eash and Waiss have mentored during the past 10 years. The students were enrolled in a nationwide program called SEED—Science Education for the Economically Disadvantaged.

The American Chemical Society, a national organization of professional chemists, sponsors the training, says chemist and American Chemical Society member Glenn Fuller at Albany. "We make sure they learn science and that they're not just stuck washing the dishes," he notes.

Fuller has convinced Eash and others to open their labs to the students. Salaries—a tax-free $1,200 for each student—come from corporations, foundations, and individual members of the Chemical Society.

High schoolers to fill SEED jobs at Albany are recruited by Elaine Yamaguchi and co-workers at Chevron Research and Technology Company in Richmond. SEED sponsors about 300 students throughout the United States each summer, according to Yamaguchi.

Eash believes that one of the most valuable lessons students learn from the ARS experience is that science in the real world "isn't always like high school science labs, where the experiments you do are always supposed to work."

Hall might agree. What impressed him the most about his weeks at Albany was learning from Eash that struggling with an experiment or making an error is normal. "A mistake," he says, "may lead you to discovering something new."—By **Marcia Wood,** ARS.

For further information about the SEED program contact Glenn Fuller or Elizabeth Ferguson at the Western Regional Research Center, USDA-ARS, 800 Buchanan Street, Albany, CA 94710. Phone (510) 559-5600. ◆

Barbara Brandon was considering a career in music, but after two summers spent mapping the genes of lentils and garbanzo beans (chickpeas), she may change her tune.

Recommended by a high school chemistry teacher for a research apprenticeship with ARS, this college sophomore has worked summers and holiday breaks for plant geneticist Chuck Simon at the ARS Grain Legume Genetics Research Laboratory in Pullman, Washington.

Gene mappers such as Simon help tomorrow's plant breeders pinpoint genes responsible for valued traits, like disease resistance.

Brandon is keeping her options open by majoring in both chemistry and piano performance at Albertson College in Caldwell, Idaho. **"An odd combination," she confesses, "but it keeps me happy. I'll probably go into science, maybe chemistry or perhaps an ag-based career."**

High school junior Cotena Carothers broke new ground at a soil science lab in Oxford, Mississippi, 3 years ago. That's when she became the first high school research apprentice at the ARS National Sedimentation Laboratory in Oxford.

Today, Carothers is a freshman at the University of Mississippi, with a 4-year scholarship in civil engineering. But she still puts in several hours a week at the ARS lab, working between classes. It's an easy commute—the lab is only a 5-minute drive from the campus.

Carothers assists ARS soil scientist Earl Grissinger. His experiments identify combinations of crops and tilling that will limit erosion of fragile topsoil in the Mississippi Valley. The region covers about one-fourth of the United States, says Grissinger.

Carothers now works mostly indoors—drying and weighing soil samples or entering data on the computer. When she was an apprentice, however, she sometimes made trips to muddy fields, bringing back samples from instruments installed at farms and watersheds. "Every time it rained," says Carothers, "we had hundreds of new soil and water samples to process."

"Working with students like Cotena is the part of my job that I enjoy the most," says mentor Maxine Nelson, an ARS physical science technician at Oxford. "You can't help being inspired by their optimism for science—and for life."

"I wasn't even interested in plants or biotechnology when I started college," remembers Rosalind Williams.

Today she's a senior research associate at one of ARS' major plant biotech labs. And her credits include assisting a research team that was among the first in the world to genetically engineer corn—a crop that had typically resisted biotechnologists' best efforts to give it new genes.

"She's gone from student to star," says Gerald G. Still, director of the ARS/University of California Plant Gene Expression Center, Albany, California, where Williams works.

Starting as a part-time lab aide during her junior year at UC, Williams landed a full-time job at the center after graduation. Now she's helping Peggy Lemaux, a UC Berkeley researcher at the Albany lab, with experiments aimed at genetically engineering barley, another grain crop that's proved recalcitrant.

Pleased with her choice of an ag science career, Williams says she may pursue a graduate degree in plant science. ARS and the university together offer about two dozen training positions at the Plant Gene Expression Center for undergrads each year.

"In just one semester with ARS, I've learned more than I would have in 2 years of college," says Purdue University senior Lonita Beliles.

A cooperative education option enabled Beliles to work full-time for four semesters at the ARS National Center for Agricultural Utilization Research in Peoria, Illinois, earning both a salary and college credit. A food science major who will graduate this spring, Beliles interspersed lab stints at Peoria with semesters of classroom study at West Lafayette, Indiana.

Lab techniques, mastered with the guidance of ARS scientist Patricia Slininger, became second nature to Beliles by the time she signed up for lab classes in microbiology, biochemistry, and food chemistry.

Working while going to college has meant that Beliles has taken 5 years, not 4, to earn her undergraduate degree. But she's satisfied with her strategy, citing the competitive edge she expects to have when she seeks a full-time job. "By taking this extra time to get hands-on work experience," she says, "I'm showing future employers that I'm more dedicated to my field."

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"I like to help prepare students for science careers," says ARS scientist Barbara Reed. **"And the research apprentice program is a good way to let students learn in the lab."**

Reed, with ARS' plant gene bank at Corvallis, Oregon, says that earlier in her career she worked with high school apprentices hired by a colleague. That inspired Reed to later apply—successfully—for the funds to bring in apprentices of her own.

Reed guides her young assistants through experiments with propagation or long-term, super-cold storage of blueberries, strawberries, hazelnuts, and a half-dozen other crops.

Her first recruit, Tracy DeWilde, has since returned for two more summers of science. Now a sophomore majoring in wildlife management at Oregon State University, DeWilde says her work with ARS has helped her "breeze through" her advanced biology classes. "We haven't convinced her to become a plant biologist yet," admits Reed, "but we're working on it."

Pregnant pigs, newly dropped lambs, and weanling calves are among the prospective patients for veterinary med students at the University of Nebraska's Great Plains Veterinary Educational Center. Each year, about 150 veterinary hopefuls sign up for 1-4 weeks of schooling there. The center is located on the grounds of ARS' Roman L. Hruska U.S. Meat Animal Research Center in south-central Nebraska.

With guidance from University of Nebraska professors, students assist with year-round medical care for animals living at the 35,000-acre ARS research center. It's a heavy patient load: the research farm is home to nearly 13,000 cattle, almost as many sheep, and some 4,500 pigs. Trainees receive college credit for their work. They can choose from more than two dozen courses, covering such topics as swine breeding, beef herd health, or animal nutrition.

Now in its third year, the center is a joint venture of the University of Nebraska, Kansas State University, and ARS. And although most of the students are from Kansas State's College of Veterinary Medicine, pre-vets from more than a dozen other veterinary medical schools around the country have also enrolled in the program.—**Linda Cooke, Julie Corliss, Marcie Gerrietts,** and **Marcia Wood,** ARS, contributed to this article.